SCAG Travel Model Improvement
Peer Review Panel

presented to
Southern California Association of Governments

presented by
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Transportation leadership you can trust.

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Overview

- Model Validation
- Vehicle Availability Model
- Trip Generation Models
  - Trip Production Models
  - Trip Attraction Models
- External Trip Models
- Mode Choice

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Status Report

- Model development
  - Trip generation and vehicle availability
  - External trip models
  - Mode choice
  - Trip assignment
- Model validation
  - Targets
  - Evaluation

Model Validation

- Approach in model validation manual (FHWA)
  - Reasonableness checks
  - Disaggregate validation
  - Aggregate model result checks
- Data sources
  - 2001 SCAG household travel survey
  - 2000 census data
  - National sources and other urban models
  - Traffic counts and transit ridership

Validation Targets

- Vehicle availability
  - By market segment
  - Households by category +/- 4 percent
  - Average vehicles per household +/- 4 percent

Validation Targets (continued)

- Trip generation
  - Comparison of rates to other urban areas
  - Total trips per household from 8.5 to 13.3 (Target 9-10)
  - Percent by trip purpose
    - Home-based work from 18 to 27 percent
    - Home-based non-work from 47 to 54 percent
    - Non-home-based from 23 to 31 percent
  - Home-based work trips per employee from 1.3 to 1.9
- Trip distribution
  - Compare trip length frequency by trip purpose to observed

Validation Targets (continued)

- Mode choice
  - Compare model parameters and derived values to other urban areas
  - Disaggregate validation by mode and market segment
  - Aggregate validation by mode and market segment
    - Develop calibration matrix from transit ridership and the household survey data
    - Regionwide trips by mode within +/- 5 percent
    - Regionwide mode shares by market segment +/- 2 percent
  - Sensitivity testing
  - Target elasticities of demand by mode with respect to level of service from -0.6 to -0.1

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Validation Targets (continued)

- External travel
  - Reasonableness checks of the parameters
- Transit assignment
  - Regional boardings +/- 10 percent
  - Market segments (no target)

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Validation Targets (continued)

- **Highway assignment**
  - **Vehicle miles traveled**
    - **VMT per household from 40 to 60**
    - **VMT per capita from 17 to 24**
    - **By facility type**
      - Freeways +/- 7 percent
      - Principal arterials +/- 10 percent
      - Minor arterials +/- 15 percent
      - Collectors +/- 25 percent)
    - **By lane use**
      - Toll roads +/- 15 percent
      - HOV lanes +/- 25 percent)
    - **By area type (+/- 10 percent)**

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Validation Targets (continued)

- **Highway assignment (continued)**
  - **Volumes**
    - **Screenlines**
      - 75% within +/- 10 percent
      - All within +/- 20 percent
      - Total within +/- 5 percent
    - **Root mean square error**
      - Freeways within 25 percent
      - Arterials within 40 percent
      - Collectors within 70 percent
      - Total within 45 percent
  - **Speeds**
    - **By facility type and area type (+/- 10 percent)**

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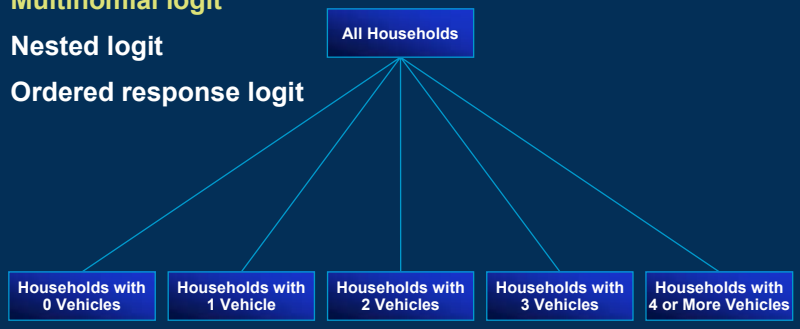
Vehicle Availability Model

- Model structures tested
  - Multinomial logit
  - Nested logit
  - Ordered response logit



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Distribution of Vehicles Available

Number of Vehicles	Vehicles Owned	Leased by Household	Leased by Employer	Leased by Other	Total Vehicles Available
0	1,663	15,542	16,773	16,468	1,059
1	6,395	1,216	156	434	5,977
2	6,168	168	10	31	6,745
3	1,941	13	0	4	2,232
4	553	0	0	1	663
5	143	0	0	1	177
6	43	0	0	0	49
7	14	0	0	0	16
8	19	0	0	0	21
Total Households	16,939	16,939	16,939	16,939	16,939
Total Vehicles	27,989	1,591	176	517	30,274
Vehicles/Household	1.652	0.094	0.010	0.031	1.787

All columns are summed independently; 'Total Vehicles Available' is not the sum of the other columns. As an example, a household that owns one vehicle and leases another has two total vehicles available.

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Independent Variables Tested

- Persons per household
- Workers per household
- Household income
- Age of head of household (over 65)
- Accessibility
  - Highway
  - Transit
  - Walk

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Estimation Results

- Income
  - Vehicle availability increases with income
- Workers in household
  - It is unlikely that the household will have more vehicles than the number of workers in the household
- Persons in household
  - The more persons there are in an household, the more vehicles are likely to be available
- Age of head of household
  - If the age of the head of the household is 65 years and older then they are more likely to have two or three vehicles available for their use
- Accessibility measures
  - If employment is within 30 minutes by transit or six miles by highway, then there is lower likelihood of have more vehicles available

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Trip Generation Models

- Use cross-classification structure
- Test independent variables
  - Persons per household
  - Workers per household
  - Household income
  - Vehicles available per household
  - Persons by age group
  - Age of head of household
- Apply MCA technique

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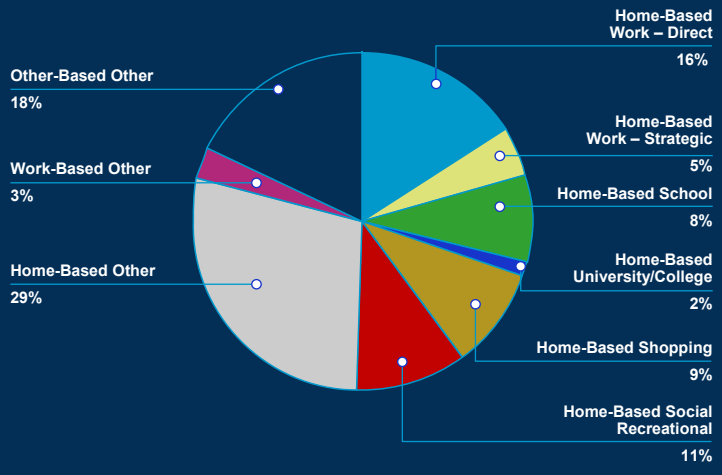
Trip Purposes



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Trip Rate Comparison
Home-Based Work Trips

	2001 Expanded Survey Results	2000 Model Validation Report	Expected Range for Validation	
			Low	High
Total Trips	10,090,406	9,051,947		
Percent of Total Trips	21%	16%	18%	27%
Trips per Household	1.87	1.69	1.53	3.59
Trips per Employee	1.35	1.22	1.30	1.90

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Trip Rate Comparison
Home-Based Non-Work Trips

	2001 Expanded Survey Results	2000 Model Validation Report	Expected Ranges from Various Sources	
			Low	High
Home-Based School				
Trips per Household	0.72	0.98	0.54	1.39
Home-Based University				
Trips per Household	0.14	0.33	0.06	0.11
Home-Based Shopping				
Trips per Household	0.83	0.94	0.90	1.05
Home-Based Social-Recreation				
Trips per Household	0.95	1.06	0.52	1.02
Home-Based Other				
Trips per Household	2.57	2.09	2.20	2.91
Total Home-Based Non-Work				
Trips per Household	5.22	5.39	4.00	7.18

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Trip Rate Comparison
Non-Home-Based Trips

	2001 Expanded Survey Results	2000 Model Validation Report	Expected Ranges from Various Sources	
			Low	High
Work-Other Trips				
Trips per Household	0.27	1.12	0.71	0.90
Other-Other Trips				
Trips per Household	1.63	2.18		1.58
Total Non-Home-Based Trips				
Trips per Household	1.89	3.31	1.96	4.12

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Potential New Purposes

Home-Based Shopping	
Percent of Total Trips	9%
Trips per Household	0.83
Trips per Retail Employee	3.53
Home-Based Quick Stop	
Percent of Total Trips	1%
Trips per Household	0.10
Trips per Retail Employee	0.42
Home-Based Other	
Percent of Total Trips	28%
Trips per Household	2.47

School-Other Trips	
Percent of Total Trips	2%
Trips per Household	0.15
Shop-Other Trips	
Percent of Total Trips	4%
Trips per Household	0.37
Other-Other Trips	
Percent of Total Trips	12%
Trips per Household	1.11

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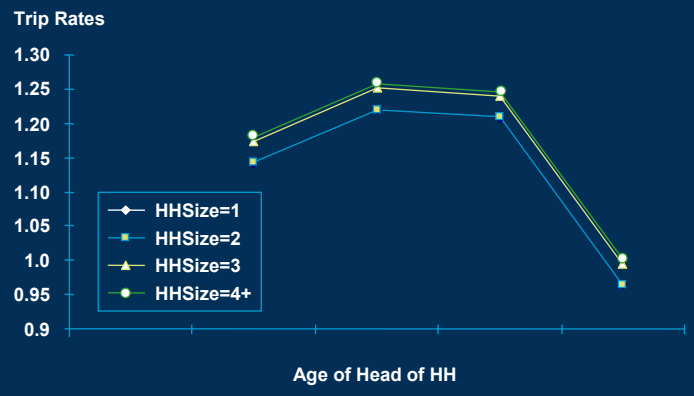
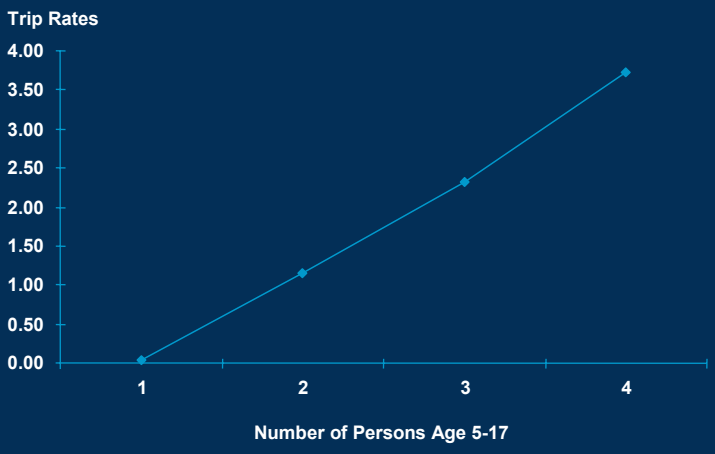
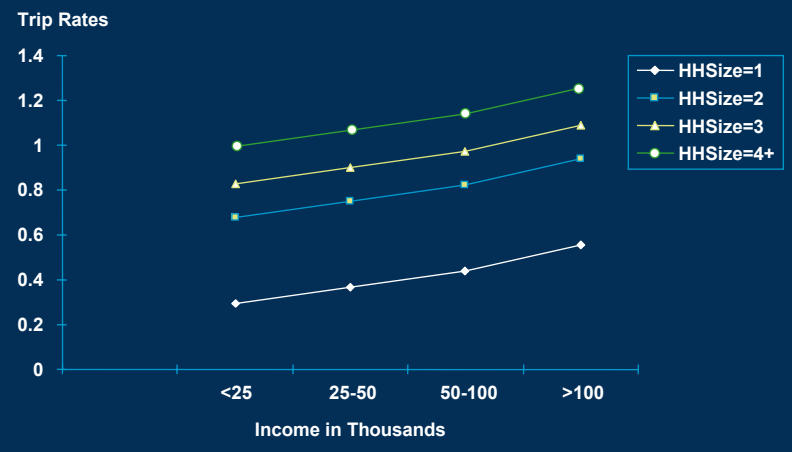
Trip Production Models
Home-Based Work Direct – 1 Worker Households



Trip Production Models
Home-Based School



Trip Production Models
Home-Based Shopping



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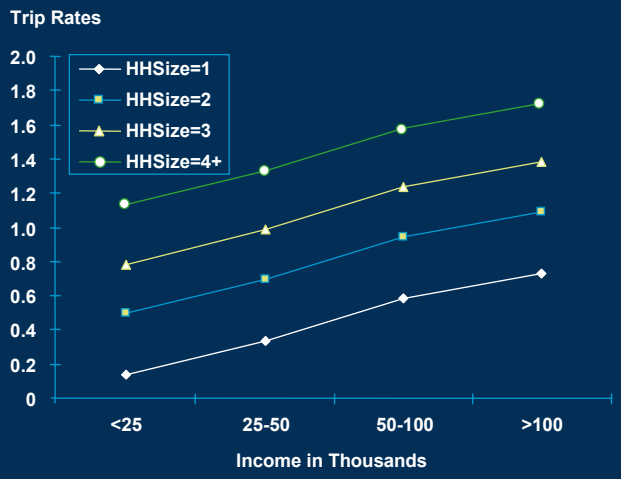
Trip Production Models
Home-based Social Recreational



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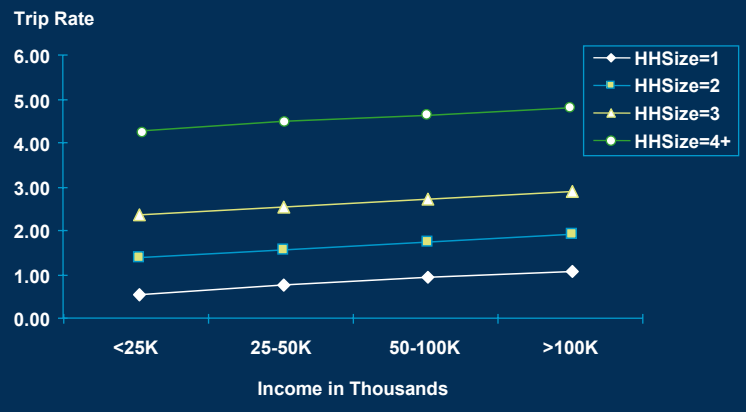
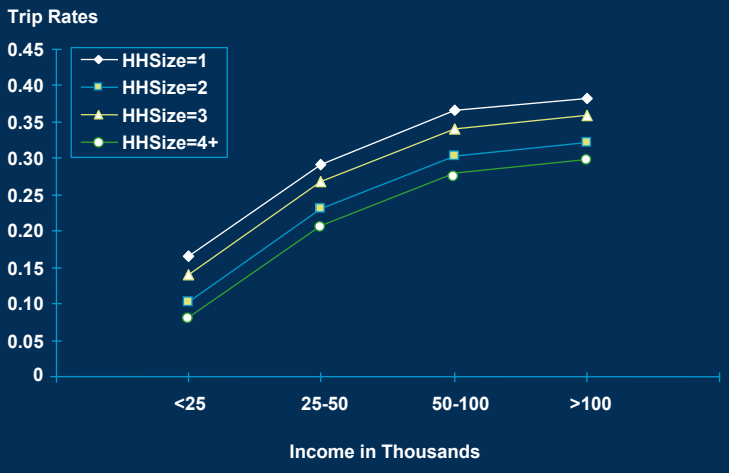
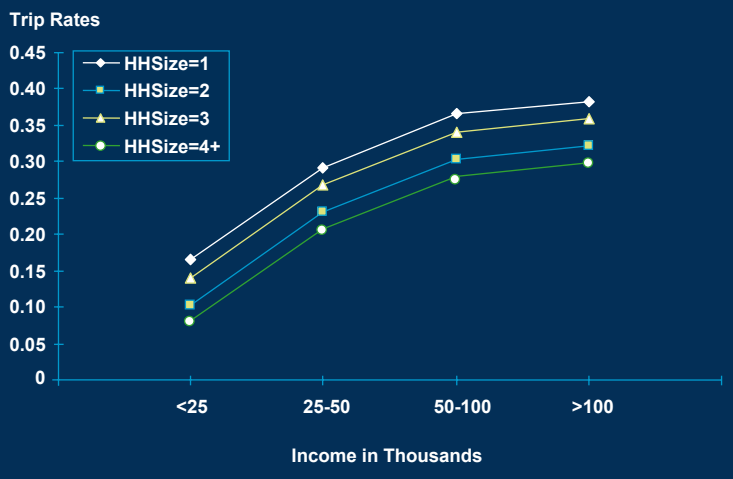
Trip Production Models
Home-based Other



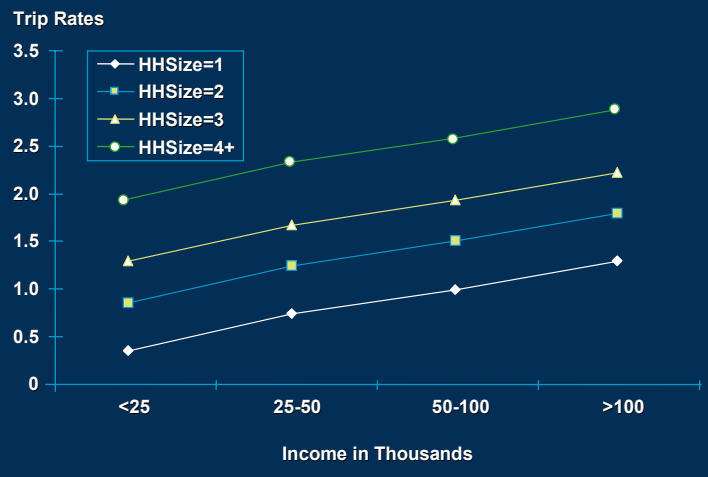
Trip Production Models
Work-based Other – 1 Worker Households



Trip Production Models
Work-based Other – 1 Worker Households



Trip Production Models
Other-based Other



Trip Attraction Models

- Merge socioeconomic zonal data with household survey
- Estimate linear regression models by purpose
  - Zone level
  - Super-zone level
  - RSA level
- Test independent variables
  - Population and households
  - Employment by type (retail, service, other)
  - Enrollment (university and K-12)

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Attraction Model Coefficients

	Household	Total	Basic	Retail	Service	Elementary	University	R-Square
Home-Based Work – Direct and Strategic		1.310						0.910
Home-Based School						1.020		0.830
Home-Based University/College							0.520	0.630
Home-Based Shopping				3.480				0.910
Home-Based Social Recreational				1.060	0.170			0.950
Home-Based Other	0.400		0.704	4.942	1.031			0.930
Work-Based Other			0.142	0.613	0.142			0.920
Other-Based Other	0.800		0.421	1.580	0.322			0.950

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Attraction Model Development

- Used RSA level geography to improve model stability
- Recommend regional rates for work, school, university and shopping trips
- Constrained household variables in home-based other and other-other models

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Under-reporting Trip Evaluation

- GPS Survey conducted by NuStats and Battelle
- Significant variables for under-reporting
  - Respondent age
  - Household income
  - Trip duration
- Adjustment weights based on household class
  - Missing age, income imputed
  - Overall adjustment of 25.6%

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Under-reporting Trip Adjustments

Description	CS Trip Rates	Adjusted Trip Rates
Home Based Work	1.87	2.35
Home Based University	0.14	0.18
Home Based School	0.72	0.90
Home Based Shopping	0.83	1.05
Home Based Social Recreational	0.95	1.20
Home Based Other	2.57	3.23
Work-Other	0.27	0.33
Other-Other	1.63	2.05
Totals	8.98	11.28

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External Trips

- Technical approach
- Survey analysis and documentation with summary tabs
- External TAZs not surveyed
- Problems associated with expanded model coverage area
- Discussion of split between X-X and I-X/X-I trips
- Folding of I-X/X-I trips into trip purposes
- Recommended procedure for forecasting external travel
- Data needs and next steps

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- **Trip Generation**
  - SCAG Household Travel Survey used to determine I-X person trip rates
- **Post Trip Gen**
  - External Cordon Survey trips, by purpose, will be subtracted from Trip Gen (TAZs near border will have more trips subtracted)
- **Post Time-of-Day**
  - External trips added back as vehicle trips by vehicle class (drive alone, SR 2, SR 3+)

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Updated Geo-Coded Cordon Surveys by Direction of Travel

Cordon	Cordon Description	East	West	North	South	Total
1	U.S. 101 – Ventura/Santa Barbara			1,255	1,269	2,524
2	SR 150 – Ventura/Santa Barbara	52	54			106
5	I-5 – Los Angeles/Kern			1,256	976	2,232
9	SR 14 – Los Angeles/Kern			556	461	1,017
10	Sierra Hwy – Los Angeles/Kern			59	64	123
12	SR 58 – East of Mojave	105	115			220
13	U.S. 395 – North of SR 58			142	66	208
15	I-15 – North of Barstow			298	244	542
16	I-40 – East of Barstow	147	101			248
18	I-10 – Indio	83	60			143
24	I-15 – Riverside/San Diego			2,374	623	2,997
26	I-5 – Orange/San Diego			2,517	2,305	4,822
	Total	387	330	8,457	6,008	15,182

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Processed Cordon Survey Vehicle Trips
Cordon Station by County of Origin and Destination

Origin County	Destination County	1	2	5	9	10	12	13	15	16	18	24	26	Grand Total
Imperial	San Diego													0
	Other	1		1			1							3
	Subtotal	*1*	*0*	*1*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*3*
Los Angeles	San Diego											23	460	483
	Other	194	1	568	378	35	3	15	111	32	14			1,351
	Subtotal	*194*	*1*	*568*	*378*	*35*	*3*	*15*	*111*	*32*	*14*	*23*	*460*	*1,834*
Orange	San Diego											10	1,340	1,350
	Other	32		168	6	1	1	28	61	15	14			326
	Subtotal	*32*	*0*	*168*	*6*	*1*	*1*	*28*	*61*	*15*	*14*	*10*	*1,340*	*1,676*
Riverside	San Diego										1	813	12	826
	Other	9		60	2		9	16	23	16	36		2	173
	Subtotal	*9*	*0*	*60*	*2*	*0*	*9*	*16*	*23*	*16*	*37*	*813*	*14*	*999*
San Bernardino	San Diego							1				46	8	55
	Other	11		58	4	1	38	29	59	62	6			268
	Subtotal	*11*	*0*	*58*	*4*	*1*	*38*	*30*	*59*	*62*	*6*	*46*	*8*	*323*

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Processed Cordon Survey Vehicle Trips
Cordon Station by County of Origin and Destination (continued)

Origin County	Destination County	1	2	5	9	10	12	13	15	16	18	24	26	Grand Total
Ventura	San Diego											1	27	28
	Other	958	58	87	11		1	1	12	7				1,135
	Subtotal	*958*	*58*	*87*	*11*	*0*	*1*	*1*	*12*	*7*	*0*	*1*	*27*	*1,163*
San Diego	Imperial													0
	Los Angeles											69	453	522
	Orange											15	1,609	1,624
	Riverside											1,555	15	1,570
	San Bernardino							1				131	8	140
	Ventura											5	30	35
	San Diego													0
	Other	14		99	3		11	25	25	7	4	30	74	292
	Subtotal	*14*	*0*	*99*	*3*	*0*	*11*	*26*	*25*	*7*	*4*	*1,805*	*2,189*	*4,183*

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Processed Cordon Survey Vehicle Trips
Cordon Station by County of Origin and Destination (continued)

Origin County	Destination County	1	2	5	9	10	12	13	15	16	18	24	26	Grand Total
Other	Imperial			1										1
	Los Angeles	201	2	514	385	55	9	6	56	20	8			1,256
	Orange	33		168	3		2	5	32	13	3			259
	Riverside	13		58		1	9	4	18	3	6			112
	San Bernardino	7		40	7	2	32	19	18	7	2			134
	Ventura	715	37	58	7		3		6	4	3			833
	San Diego	31		92	2		4	10	20	6	1	5	80	251
	Other													0
	Subtotal	*1000*	*39*	*931*	*404*	*58*	*59*	*44*	*150*	*53*	*23*	*5*	*80*	*2,846*
	Total	2,219	98	1,972	808	95	123	160	441	192	98	2,703	4,118	13,027

Note: Data processing included removal of illogical records and incorporates changes associated with cordon mismatches to model coverage area.

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Cordon Survey Trip Purpose Shares

Loc	Description	Trip Purposes Shares of Total Travel (Passenger Vehicles)							
		HBW	HBCol	HBSH	HBSR	HBO	NHBO	NHBW	Total
1	U.S. 101 – Ventura/Santa Barbara	61%	4%	2%	13%	13%	2%	5%	100%
2	SR 150 – Ventura/Santa Barbara	62%	5%	3%	10%	14%	3%	3%	100%
5	I-5 – Los Angeles/Kern	17%	4%	1%	42%	28%	3%	6%	100%
9	SR 14 – Los Angeles/Kern	59%	6%	6%	11%	12%	3%	3%	100%
10	Sierra Hwy – LA/Kern	43%	10%	7%	8%	23%	2%	7%	100%
12	SR 58 – East of Mojave	28%	0%	1%	43%	18%	4%	7%	100%
13	U.S. 395 – North of SR 58	13%	1%	3%	41%	35%	3%	4%	100%
15	I-15 – North of Barstow	3%	0%	1%	75%	13%	4%	4%	100%
16	I-40 – East of Barstow	10%	0%	2%	60%	23%	2%	3%	100%
18	I-10 – Indio	23%	1%	3%	52%	16%	2%	3%	100%
24	I-15 – Riverside/San Diego	68%	3%	2%	11%	11%	1%	5%	100%
26	I-5 – Orange/San Diego	49%	2%	2%	20%	17%	2%	7%	100%
	Average All Cordons	45%	3%	2%	26%	16%	2%	5%	100%
	2001 SCAG HH Survey (Internal Trips, All Modes)	21%	10%	9%	11%	29%	3%	18%	100%

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Weighting Factors for Cordon 26 – I-5 at Orange/San Diego County Line

SCAG Model Time Period	Observed Counts		Cordon Survey		TOD/Dir Weights	
	NB	SB	NB	SB	NB	SB
AM 0600-0859	11,091	9,995	603	259	18.39	38.59
Mid 0900-1459	22,235	22,520	689	679	32.27	33.16
PM 1500-1859	13,873	14,554	455	655	30.49	22.21
NT 1900-0559	17,920	20,677	377	405	47.53	51.05
Total	65,119	67,746	2,124	1,998		

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Cordon Survey Time-of-Day Shares

Loc	Description	Percent of Total Daily				
		AM Peak (6:00 a.m.-9:00 a.m.)	Midday (9:00 a.m.-3:00 p.m.)	PM Peak (3:00 p.m.-7:00 p.m.)	Night (7:00 p.m.-6:00 a.m.)	Total
1	U.S. 101 – Ventura/Santa Barbara	29%	27%	32%	12%	100.0%
2	SR 150 – Ventura/Santa Barbara	34%	26%	41%	0%	100.0%
5	I-5 – Los Angeles/Kern	11%	35%	33%	21%	100.0%
9	SR 14 – Los Angeles/Kern	22%	25%	35%	18%	100.0%
10	Sierra Hwy – LA/Kern	20%	35%	45%	0%	100.0%
12	SR 58 – East of Mojave	14%	39%	34%	13%	100.0%
13	U.S. 395 – North of SR 58	18%	47%	19%	16%	100.0%
15	I-15 – North of Barstow	6%	70%	24%	0%	100.0%
16	I-40 – East of Barstow	12%	43%	22%	22%	100.0%
18	I-10 – Indio	12%	48%	30%	11%	100.0%
24	I-15 – Riverside/San Diego	27%	24%	37%	12%	100.0%
26	I-5 – Orange/San Diego	16%	34%	29%	21%	100.0%
	Average All Cordons	21%	32%	33%	14%	100.0%

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Cordon Survey Vehicle Occupancy Shares

Loc	Description	Vehicle Occupancy Shares				AVO
		1 Occ	2 Occ	3+ Occ	Total	
1	U.S. 101 – Ventura/Santa Barbara	52%	28%	20%	100%	1.40
2	SR 150 – Ventura/Santa Barbara	66%	25%	9%	100%	1.24
5	I-5 – Los Angeles/Kern	25%	40%	36%	100%	1.85
9	SR 14 – Los Angeles/Kern	54%	24%	22%	100%	1.40
10	Sierra Hwy – LA/Kern	39%	43%	18%	100%	1.52
12	SR 58 – East of Mojave	27%	49%	25%	100%	1.72
13	U.S. 395 – North of SR 58	20%	53%	27%	100%	1.85
15	I-15 – North of Barstow	13%	57%	30%	100%	2.00
16	I-40 – East of Barstow	13%	49%	38%	100%	2.12
18	I-10 – Indio	23%	41%	36%	100%	1.86
24	I-15 – Riverside/San Diego	30%	41%	29%	100%	1.75
26	I-5 – Orange/San Diego	55%	27%	19%	100%	1.38
	Average All Cordons	51%	29%	20%	100%	1.41

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External Cordons and Recommendations for Unsurveyed Locations

Cordon Station	External TAZ	Location (County/Street)	Cordon #	Use Direction, Time-of-Day, and Trip Purpose Assumptions from:
1	4107	Ventura/U.S. 101	1	
2	4108	Ventura/Rt. 150	2	
3	4109	Ventura/Rt. 33		Cordon 1
4	4110	Ventura/Lockwood Valley Rd		Cordon 5
5	4111	LA/I-5	5	
6	4112	LA/90th St W		Cordon 9
7	4113	LA/60th St W		Cordon 9
8	4114	LA/Rt. 14	9	
9	4115	LA/Sierra Hwy	10	
10	4116	LA/120th St E		Cordon 10
11	4117	LA/200th St E		Cordon 12
12	4118	SB/Rt. 58	12	
13	4119	SB/U.S. 395	13	
14	4120	SB/Rt. 178		Cordon 13
15	4121	SB/Trona Rd		Cordon 13
16	4122	SB/Rt. 127		Cordon 15
17	4123	SB/Mesquite Valley Rd		Cordon 15
18	4124	SB/Kingston Rd		Cordon 15
19	4125	SB/I-15	15	
20	4126	SB/Nipton Rd		Cordon 15

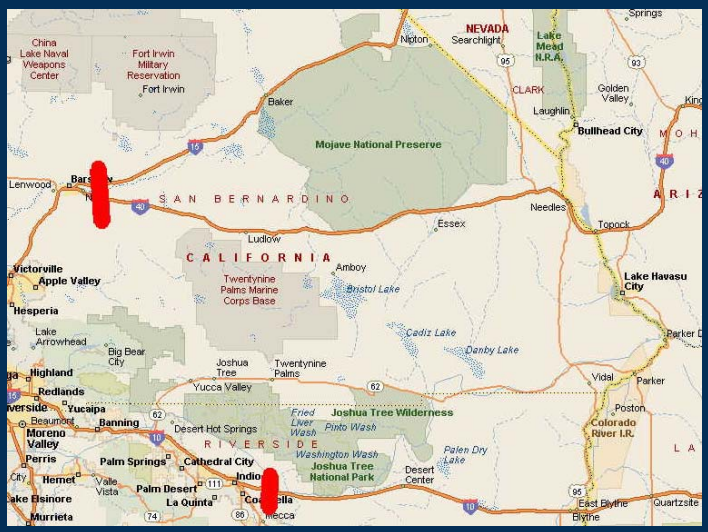
CAMBRIDGE SYSTEMATICS

External Cordons and Recommendations for Unsurveyed Locations (continued)

Cordon Station	External TAZ	Location (County/Street)	Cordon #	Use Direction, Time-of-Day, and Trip Purpose Assumptions from:
21	4127	SB/U.S. 95		Cordon 16
22	4128	SB/Needles Hwy		Cordon 16
23	4129	SB/I-40	16	
24	4130	SB/Parker Dam Rd		Cordon 16
25	4131	SB/Rt. 62		Cordon 16
26	4132	Riverside/I-10	18	
27	4133	Imperial/I-8		Forthcoming
28	4134	Imperial/Rt. 186		Imperial I-8
29	4135	Imperial/Rt. 7		Regional values
30	4136	Imperial/Rt. 111		Regional values
31	4137	Imperial/I-8 (San Diego)		Forthcoming
32	4138	Imperial/Rt. 78		Regional values
33	4139	Imperial/S22–Bor. Salton Seaway		Regional values
34	4140	Riverside/Rt. 79		Cordon 24
35	4141	Riverside/S16 – Temecula Rd		Cordon 24
36	4142	Riverside/I-15	24	
37	4143	Riverside/Sandia Creek Dr		Regional values
38	4144	Riverside/De Luz Rd		Regional values
39	4145	Riverside/Tenaja Rd		Regional values
40	4146	Orange/I-5	26	

CAMBRIDGE SYSTEMATICS

External Cordons (Red) Versus Expanded SCAG Model Coverage Area (State Line)



CAMBRIDGE SYSTEMATICS

Cordon Survey Locations Affected by Expanded Model Coverage Area

Cordon	Description	SCAG Model Coverage area change	AADT at Cordon*	AADT at State Line*
15	I-15 – North of Barstow	Moved to Stateline	35,000	35,000
16	I-40 – East of Barstow	Moved to Stateline	14,000	12,500
18	I-10 – Indio	Moved to Stateline	21,000	24,000
21	SR 86 – Riverside/ Imperial	Not longer relevant – Imperial County included in model area	–	–

*Source: Caltrans Traffic Volume Report for 2002.

CAMBRIDGE SYSTEMATICS

Breakdown of Cordon Survey External Travel with Expanded Model System

Between	And	I-15	I-40	I-10
External-External				
Beyond State Line	Other (San Diego)	45	13	5
Internal-External/External-Internal				
Beyond State Line	Los Angeles, Orange, Ventura	278	91	42
Beyond State Line	West San Bernardino/Riverside	91	41	20
East San Bernardino/Riverside	Other (San Diego)	0	0	1
Internal for expanded model area				
East San Bernardino/Riverside	Los Angeles, Orange, Ventura	1	15	12
East San Bernardino/Riverside	West San Bernardino/Riverside	27	43	30
Total		442	203	110
% External-External		10%	6%	5%
% Internal-External/External-Internal		83%	65%	57%
% Now Internal		6%	29%	38%

Source: 2003 SCAG External Cordon Survey. I-15 and I-40 cordons located east of Barstow and I-10 cordon located east of Indio.

CAMBRIDGE SYSTEMATICS

Recommended Updated Cordon Survey Usage for Expanded Model Coverage Area

Between	And	I-15	I-40	I-10
External-External				
Beyond State Line	Other (San Diego)	45	13	5
Internal-External/External-Internal				
Beyond State Line	Los Angeles, Orange, Ventura	278	91	42
Beyond State Line	West San Bernardino/Riverside	91	41	20
East San Bernardino/Riverside	Other (San Diego)	0	0	1
East San Bernardino/Riverside	Beyond State Line	27	43	30
Dropped				
East San Bernardino/Riverside	Los Angeles, Orange, Ventura	1	15	12
Total		442	203	110
% External-External		10%	6%	5%
% Internal-External/External-Internal		90%	86%	85%
Dropped		0%	7%	11%

CAMBRIDGE SYSTEMATICS

Cordon Survey External-External and Internal-External/External-Internal Split

Cordon	Cordon Description	I-X/X-I	X-X	Dropped
1	U.S. 101 – Ventura/Santa Barbara	98%	2%	–
2	SR 150 – Ventura/Santa Barbara	100%	0%	–
5	I-5 – Los Angeles/Kern	89%	11%	–
9	SR 14 – Los Angeles/Kern	99%	1%	–
10	Sierra Hwy – Los Angeles/Kern	100%	0%	–
12	SR 58 – East of Mojave	87%	13%	–
13	U.S. 395 – North of SR 58	76%	24%	–
15	I-15 – North of Barstow	90%	10%	0.2%
16	I-40 – East of Barstow	86%	6%	7%
18	I-10 – Indio	85%	5%	11%
24	I-15 – Riverside/San Diego	99%	1%	–
26	I-5 – Orange/San Diego	96%	4%	–
	Total/Average	96%	4%	

CAMBRIDGE SYSTEMATICS

Unweighted External-External Trip Ends by Trip Leg, Direction, and Time-of-Day

		AM Peak Period (6:00 a.m.-9:00 a.m.)				Midday Period (9:00 a.m.-3:00 p.m.)			
		Origins		Destinations		Origins		Destinations	
		NB/ EB	SB/ WB	NB/ EB	SB/ WB	NB/ EB	SB/ WB	NB/ EB	SB/ WB
1	U.S. 101 – Ventura/Sta Barbara	–	2	0	–	–	23	9	–
5	I-5 – Los Angeles/Kern	–	10	18	–	–	62	68	–
9	SR 14 – Los Angeles/Kern	–	1	1	–	–	2	1	–
12	SR 58 – East of Mojave	0	–	–	0	2	–	–	9
13	U.S. 395 – North of SR 58	–	1	4	–	–	6	11	–
15	I-15 – North of Barstow	–	1	8	–	–	21	68	–
16	I-40 – East of Barstow	–	0	2	–	–	4	4	–
18	I-10 – Indio	–	0	0	–	–	0	2	–
24	I-15 – Riverside/San Diego	12	–	–	2	64	–	–	34
26	I-5 – Orange/San Diego	21	–	–	13	108	–	–	86
	Total	33	15	33	15	174	118	163	129

CAMBRIDGE SYSTEMATICS

Unweighted External-External Trip Ends by Trip Leg, Direction, and Time-of-Day (continued)

		PM Peak Period (3:00 p.m.-7:00 p.m.)				Late Night Period (7:00 p.m.-6:00 a.m.)			
		Origins		Destinations		Origins		Destinations	
		NB/ EB	SB/ WB	NB/ EB	SB/ WB	NB/ EB	SB/ WB	NB/ EB	SB/ WB
1	U.S. 101 – Ventura/Sta Barbara	–	3	2	–	–	3	3	–
5	I-5 – Los Angeles/Kern	–	43	25	–	–	49	26	–
9	SR 14 – Los Angeles/Kern	–	0	0	–	–	0	0	–
12	SR 58 – East of Mojave	1	–	–	2	1	–	-	0
13	U.S. 395 – North of SR 58	–	1	2	–	–	3	7	–
15	I-15 – North of Barstow	–	4	10	–	–	2	10	–
16	I-40 – East of Barstow	–	1	2	–	–	0	0	–
18	I-10 – Indio	–	1	2	–	–	0	0	–
24	I-15 – Riverside/San Diego	15	–	–	8	9	–	–	3
26	I-5 – Orange/San Diego	30	–	–	46	37	–	–	55
	Total	46	53	43	56	47	57	46	58

Note: Some data messaging was done to maximize survey records. In some instances, origin/ destination did not match with direction of travel. For example, a northbound trip cannot use Cordon 1 (U.S. 101 Ventura/Santa Barbara) as the origin cordon. In these cases, origins and destinations were reversed. In some other cases, either the origin or destination cordon was not known, or an educated guess was made as to the destination cordon.

CAMBRIDGE SYSTEMATICS

Externals: Next Steps

- Obtain traffic counts by hour (or SCAG time period) and direction for all external cordon locations (except I-5 at the San Diego-Orange County Line)
- Obtain geo-coded I-8 cordon survey data on either end of Imperial County
- Document California Statewide Model loaded daily highway network volumes at SCAG external cordons
- Determine SCAG 2001 Household Survey average trip lengths for the internal portion of I-X/X-I trips

CAMBRIDGE SYSTEMATICS

Pedestrian Environment Factor
Walk Friendliness Factors

- Variables Considered
  - Number of local street intersections per SQML
  - Ratio of sidewalk miles to street miles
  - Building setbacks and orientation
  - Streets and walkways connectivity
  - Ease of street crossing
  - Terrain and topography
  - Land Use Mix/employment & residential densities
  - Housing and employment balance/livable community
- Variables Selected
  - Number of non-highway street intersections per SQML
  - Length of non-highway streets per SQML
  - Average grade per mile of non-highway streets
  - Land use mix/employment and residential densities

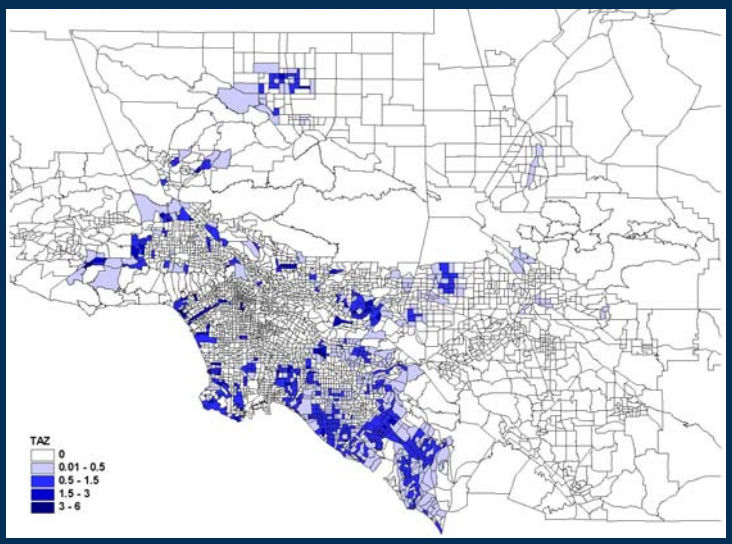
CAMBRIDGE SYSTEMATICS

Pedestrian Environment Factor
Bicycle-Friendliness Factors

- Variables Considered
  - Miles of restricted bicycle ROW per SQML
  - Miles of separated bicycle ROW per SQML
  - Miles of signed bicycle ROW per SQML
  - Total miles of bicycle ROW per SQML

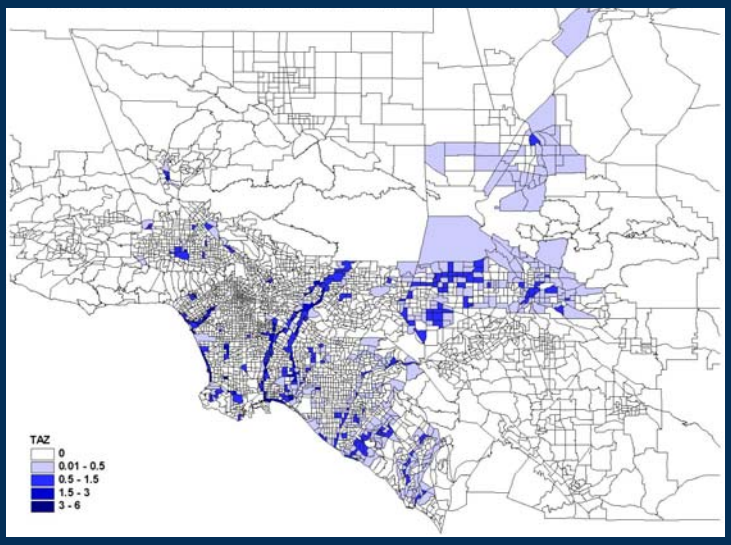
CAMBRIDGE SYSTEMATICS

Miles of Restricted Bicycle Right-of-Way Per Square Mile



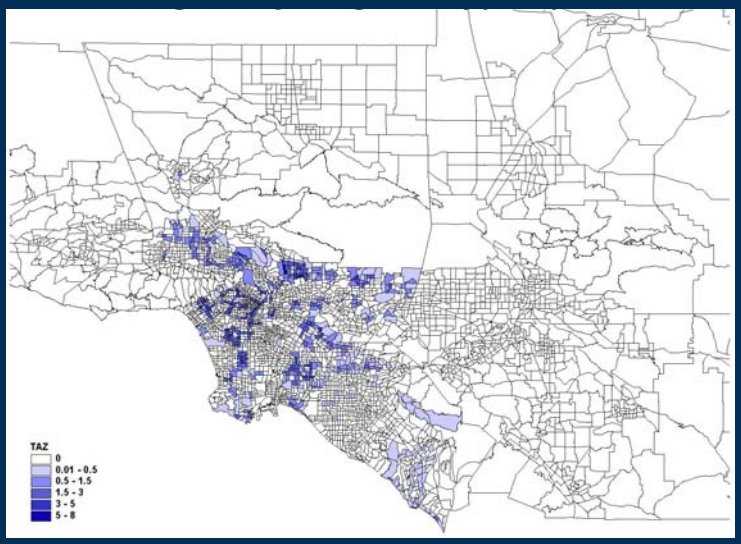
CAMBRIDGE SYSTEMATICS

Miles of Separated Bicycle Right-of-Way Per Square Mile



CAMBRIDGE SYSTEMATICS

Miles of Signed Bicycle Right-of-Way Per Square Mile



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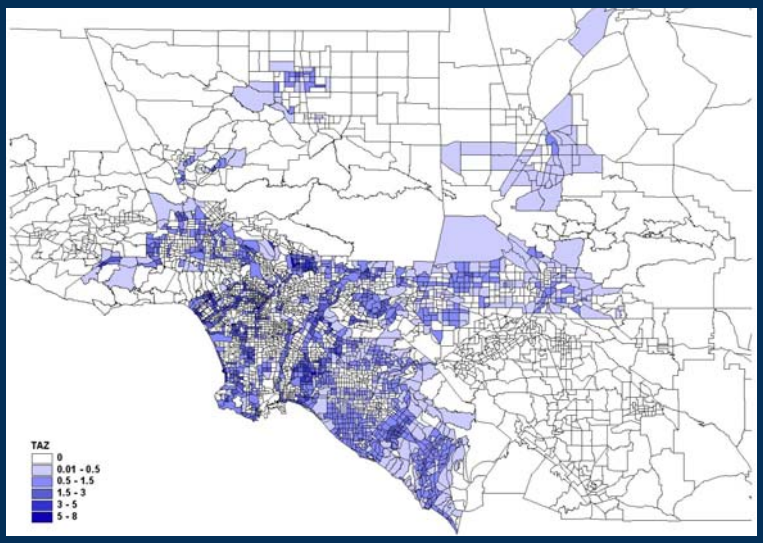
Total Miles of Bicycle Right-of-way Per Square Mile



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